What is claimed is:

1. A digital vestigial sideband (VSB) transmission system comprising:

5 a supplemental data processor receiving input supplemental data and inserting systematic Read-Solomon parity bytes, a first predefined sequence, and an MPEG header into said input supplemental data;

a first multiplexer multiplexing MPEG data with said input supplemental data processed in said supplemental data processor to generate a set of data segments, each of which is any one of a supplemental data segment and an MPEG data segment;

a first encoding part generating a supplemental data symbol for each supplemental data segment by initially relocating said systematic parity bytes to be placed after information bytes for each supplemental data segment and substituting nonsystematic parity bytes for said relocated systematic parity bytes;

a supplemental data symbol processor generating first and second data bits for each supplemental data symbol, said first data bit being generated by post-decoding an information bit of each supplemental data symbol, said second data bit being generated by encoding said information bit with a 1/2 coding rate and multiplexing said encoded information bit with said first predefined sequence; and

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a VSB transmitter processing said data bits generated in said supplemental data symbol processor including trellis encoding and VSB modulating and subsequently transmitting said modulated data to a receiving side.

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2. The VSB transmission system of claim 1, wherein said first encoding part includes:

a data randomizer randomizing each supplemental data segment generated in said first multiplexer;

10   a parity place holder inserter determining a parity place holder and inserting null bytes into parity places determined by said holder for each supplemental data segment randomized in said data randomizer;

a data interleaver interleaving said each supplemental 15 data segment processed in said parity place holder inserter so that said systematic parity bytes are placed after said information bytes;

a parity substituting part substituting said nonsystematic parity bytes for said null bytes for each 20 supplemental data segment interleaved in said data interleaver;

a byte-symbol converter converting each supplemental data segment processed in said parity substituting part into said supplemental data symbol;

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a symbol-byte converter converting said supplemental data symbol for each supplemental data segment into corresponding bytes; and

a nonsystematic Read-Solomon encoder performing a nonsystematic Read-Solomon encoding process on said data converted in said symbol-byte converter in order to provide said nonsystematic parity bytes to said parity substituting part for each supplemental data segment.

3. The VSB transmission system of claim 2, wherein said parity place holder inserter determines said parity places by initially determining said parity place holder, inserting said null bytes into said determined parity places, and inserting said information bytes in all other places for each supplemental data segment randomized in said data randomizer.

4. The VSB transmission system of claim 3, wherein said parity places are determined by the following equation:

$$b = ((52 \times p) + (s \bmod 52)) \bmod 207$$
$$\text{for } p = 187,188,...,206$$

where s represents a segment number (0-311) of each supplemental data segment; and b represents each of said parity places (0-206) for each supplemental data segment;

5. The VSB transmission system of claim 4, wherein said parity place holder inserts first three bytes of said information bytes as first three bytes of each supplemental data segment regardless of said determined parity places and inserts all other information bytes into non-parity places for each supplemental data segment if said segment number s is any one of 1-7, 53-59, 105-111, 157-163, 209-215, and 261-167.

6. The VSB transmission system of claim 2, wherein said nonsystematic Read-Solomon encoder uses a generator matrix corresponding to said determined parity place holder of each supplemental data segment.

7. The VSB transmission system of claim 1, wherein said supplemental data symbol processor includes:

a precoder-bypassing part post-decoding said information bit of each supplemental data symbol to generate said first data bit;

a 1/2 rate convolutional encoder encoding said information bit of each supplemental data symbol with said 1/2 coding rate; and

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a second multiplexer multiplexing said encoded information bit of each supplemental data symbol with said first predefined sequence to generate said second data bit.

5   8. The VSB transmission system of claim 7, wherein said precoder-bypassing part includes:

a modified precoder having a second precoder and enabling said information bit of each supplemental data symbol to bypass said second precoder; and

10   a post-decoder post-decoding said information bit bypassed in said modified precoder.

9. The VSB transmission system of claim 7, wherein said 1/2 rate convolutional encoder includes:

a first selecting element selecting a previous second register value for each supplemental data symbol;

a first register storing said value selected by said first selecting element;

an adder adding said value stored in said first

20   register and said information bit of each supplemental data symbol;

a second selecting element selecting said value added by said adder for each supplemental data symbol;

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a second register storing said value selected by said second selecting element; and

a third selecting element selecting said value stored in said second register for each supplemental data symbol, wherein said previous second register value is a value previously stored in said second register.

10. The VSB transmission system of claim 1, wherein said first encoding part generates an MPEG data symbol for each MPEG data segment by carrying out processes on each MPEG data segment generated by said first multiplexer including data randomizing, Read-Solomon encoding, data interleaving, and byte-symbol converting.

11. The VSB transmission system of claim 10, wherein said supplemental data symbol processor generates third and fourth data bits for each MPEG data symbol generated in said first encoding part, said third data bit being generated by precoding and post-decoding an information bit of each MPEG data symbol, said fourth data bit being a second predefined sequence included in each MPEG data symbol.

12. The VSB transmission system of claim 11, wherein said first encoding part includes:

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a data randomizer randomizing each MEPG data segment generated in said first multiplexer;

a Read-Solomon encoder encoding each MPEG data segment randomized in said data randomizer;

5   a data interleaver interleaving each MPEG data segment encoded in said Read-Solomon encoder; and

a byte-symbol converter converting each MPEG data segment interleaved in said data interleaver into said MEPG data symbol.

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13. The VSB transmission system of claim 11, wherein said supplemental data symbol processor includes:

a precoder-bypassing part generating said third data bit by precoding and post-decoding said information bit of each
15   MPEG data symbol;

a 1/2 rate convolutional encoder outputting said second predefined sequence; and

a second multiplexer generating said fourth data bit by outputting said second predefined sequence included in each MPEG
20   data symbol

14. The VSB transmission system of claim 13, wherein said precoder-bypassing part includes:

a modified precoder precoding said information bit of
each MPEG data symbol; and

a post-decoder post-decoding said information bit of
each MPEG data symbol precoded in said modified precoder.

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15. The VBS transmission system of claim 13, wherein said
1/2 rate convolutional encoder includes:

a first selecting element selecting a previous first
register value for each MPEG data symbol;

a first register storing said value selected by said
first selecting element for each MPEG data symbol;

an adder adding said value stored in said first
register and said information bit of each MPEG data symbol;

a second selecting element selecting a previous second
register value for each MPEG data symbol;

a second register storing said value selected by said
second selecting element for each MPEG data symbol; and

a third selecting element selecting said predefined
sequence for each MPEG data symbol,

20 wherein said previous first and second register values are values
previously stored in said first and second registers,
respectively.

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16. A digital vestigial sideband (VSB) transmission system comprising:

a precoder-bypassing part generating a first data bit by post-decoding an information bit of a supplemental data symbol;

a 1/2 rate convolutional encoder encoding said information bit with a 1/2 coding rate;

a multiplexer selecting said encoded information bit as a second data bit;

a first precoder generating a third data bit by precoding said first data bit;

a trellis encoder generating a fourth data bit by directly outputting said second data bit and generating a fifth data bit by trellis-encoding said second data bit; and

a VSB modulator generating a modulation value based on said third, fourth, and fifth data bits received from said first precoder and trellis encoder.

17. The VSB transmission system of claim 16, wherein said precoder-bypassing part includes:

a modified precoder having a second precoder and enabling said information bit to bypass said second precoder; and

a post-decoder post-decoding said information bit bypassed in said modified precoder.

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18. The VSB transmission system of claim 16, wherein said 1/2 rate convolutional encoder includes:

a first selecting element selecting a previous second register value for said supplemental data symbol received;

a first register storing said value selected by said first selecting element;

an adder adding said value stored in said first register and said information bit of said supplemental data symbol;

a second selecting element selecting said value added by said adder;

a second register storing said value selected by said second selecting element; and

a third selecting element selecting said value stored in said second register,

wherein said previous second register value is a value previously stored in said second register.

19. The VSB transmission system of claim 16, wherein said encoding part generates an MPEG data symbol for each MPEG data segment by carrying out processes on each MPEG data segment generated by said first multiplexer including data randomizing,

Read-Solomon encoding, data interleaving, and byte-symbol converting.

20. The VSB transmission system of claim 19, wherein said supplemental data symbol processor generates third and fourth data bits for each MPEG data symbol generated in said first encoding part, said third data bit being generated by precoding and post-decoding an information bit of each MPEG data symbol, said fourth data bit being a second predefined sequence included in each MPEG data symbol.

21. A Vestigial Sideband (VSB) receiving system for receiving and transmitting digital broadcasting signals, said receiving system comprising:

a supplemental data processor receiving input supplemental data and inserting systematic Read-Solomon parity bytes, a first predefined sequence, and an MPEG header into said input supplemental data;

a first multiplexer multiplexing MPEG data with said input supplemental data processed in said supplemental data processor to generate a set of data segments, each of which is any one of a supplemental data segment and an MPEG data segment;

a first encoding part generating a supplemental data symbol for each supplemental data segment by initially relocating

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said systematic parity bytes to be placed after information bytes for each supplemental data segment and substituting nonsystematic parity bytes for said relocated systematic parity bytes;

a supplemental data symbol processor generating first and second data bits for each supplemental data symbol, said first data bit being generated by post-decoding an information bit of each supplemental data symbol, said second data bit being generated by encoding said information bit with a 1/2 coding rate and multiplexing said encoded information bit with said first predefined sequence; and

a VSB transmitter processing said data bits generated in said supplemental data symbol processor including trellis encoding and VSB modulating and subsequently transmitting said modulated data to a receiving side.

22. The VSB transmission system of claim 21, wherein said first encoding part includes:

a data randomizer randomizing each supplemental data segment generated in said first multiplexer;

a parity place holder inserter determining a parity place holder and inserting null bytes into parity places determined by said holder for each supplemental data segment randomized in said data randomizer;

a data interleaver interleaving said each supplemental data segment processed in said parity place holder inserter so that said systematic parity bytes are placed after said information bytes;

5   a parity substituting part substituting said nonsystematic parity bytes for said null bytes for each supplemental data segment interleaved in said data interleaver;

a byte-symbol converter converting each supplemental data segment processed in said parity substituting part into said supplemental data symbol;

a symbol-byte converter converting said supplemental data symbol for each supplemental data segment into corresponding bytes; and

a nonsystematic Read-Solomon encoder performing a nonsystematic Read-Solomon encoding process on said data converted in said symbol-byte converter in order to provide said nonsystematic parity bytes to said parity substituting part for each supplemental data segment.

20   23. The VSB transmission system of claim 22, wherein said parity place holder inserter determines said parity places by initially determining said parity place holder, inserting said null bytes into said determined parity places, and inserting said

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information bytes in all other places for each supplemental data segment randomized in said data randomizer.

24. The VSB transmission system of claim 23, wherein said parity places are determined by the following equation:

$$b = ((52 \times p) + (s \bmod 52)) \bmod 207$$
$$\text{for } p = 187,188,...,206$$

where s represents a segment number (0-311) of each supplemental data segment; and b represents each of said parity places (0-206) for each supplemental data segment;

25. The VSB transmission system of claim 24, wherein said parity place holder inserts first three bytes of said information bytes as first three bytes of each supplemental data segment regardless of said determined parity places and inserts all other information bytes into non-parity places for each supplemental data segment if said segment number s is any one of 1-7, 53-59, 105-111, 157-163, 209-215, and 261-167.

26. The VSB transmission system of claim 22, wherein said nonsystematic Read-Solomon encoder uses a generator matrix corresponding to said determined parity place holder of each supplemental data segment.

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27. The VSB transmission system of claim 21, wherein said supplemental data symbol processor includes:

a precoder-bypassing part post-decoding said information bit of each supplemental data symbol to generate said first data bit;

a 1/2 rate convolutional encoder encoding said information bit of each supplemental data symbol with said 1/2 coding rate; and

a second multiplexer multiplexing said encoded information bit of each supplemental data symbol with said first predefined sequence to generate said second data bit.

28. The VSB transmission system of claim 27, wherein said precoder-bypassing part includes:

a modified precoder having a second precoder and enabling said information bit of each supplemental data symbol to bypass said second precoder; and

a post-decoder post-decoding said information bit bypassed in said modified precoder.

29. The VSB transmission system of claim 27, wherein said 1/2 rate convolutional encoder includes:

a first selecting element selecting a previous second register value for each supplemental data symbol;

a first register storing said value selected by said first selecting element;

5   an adder adding said value stored in said first register and said information bit of each supplemental data symbol;

a second selecting element selecting said value added by said adder for each supplemental data symbol;

10   a second register storing said value selected by said second selecting element; and

a third selecting element selecting said value stored in said second register for each supplemental data symbol, wherein said previous second register value is a value previously

15   stored in said second register.